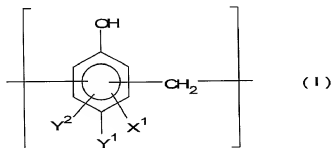


Claims

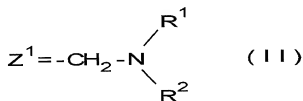
1. A coated metal article having on its surface a coating suitable for film lamination thereon, wherein:

- said coating has a thickness that is from 5 to 500 nm;
- said coating has a content of carbon atoms that corresponds to from 5 to 500 mg/m<sup>2</sup> of the coating area;
- said coating covers at least 90 % of the surface of the metal; and
- said coating comprises polymer molecules that comprise units conforming to general formula (I):



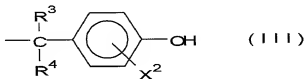
in which:

X<sup>1</sup> independently in each structural unit is a hydrogen atom or a moiety Z<sup>1</sup> conforming to general formula (II):

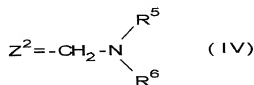


in which each of R<sup>1</sup> and R<sup>2</sup> independently is a hydrogen atom, a C<sub>1</sub> to C<sub>10</sub> monovalent alkyl moiety, or a C<sub>1</sub> to C<sub>10</sub> monovalent hydroxyalkyl moiety;

Y<sup>1</sup>, independently for each unit, is a hydrogen atom, a hydroxyl group, a C<sub>1</sub> to C<sub>5</sub> alkyl moiety, a C<sub>1</sub> to C<sub>5</sub> hydroxyalkyl moiety, a C<sub>6</sub> to C<sub>12</sub> aryl, benzyl, or benzo moiety, or a moiety conforming to general formula (III):



in which, independently for each unit according to general formula (I) in which  $Y^1$  conforms to general formula (III), each of  $R^3$  and  $R^4$  is independently a hydrogen atom, a  $C_1$  to  $C_{10}$  alkyl moiety, or a  $C_1$  to  $C_{10}$  hydroxyalkyl moiety, and  $X^2$  is a hydrogen atom or a moiety  $Z^2$  conforming to general formula (IV):



in which each of  $R^5$  and  $R^6$  is independently a hydrogen atom, a  $C_1$  to  $C_{10}$  alkyl moiety, or a  $C_1$  to  $C_{10}$  hydroxyalkyl moiety;

and

$Y^2$ , independently for each unit, is a hydrogen atom or, when  $Y^1$  and  $Y^2$  are bonded to adjacent carbon atoms in the aromatic ring shown in general formula (I),  $Y^1$ ,  $Y^2$ , and said adjacent carbon atoms to which  $Y^1$  and  $Y^2$  are bonded together may constitute a condensed benzene ring,

said polymer molecules that comprise structural units conforming to general formula (I) having a total number of  $Z^1$  and  $Z^2$  moieties and a distinct (but not necessarily unequal) total number of (i) units conforming to general formula (I) and (ii)  $Y^1$  moieties that conform to general formula (III), such that the total number of  $Z^1$  and  $Z^2$  moieties has a ratio to the total number of units conforming to general formula (I) and  $Y^1$  moieties that conform to general formula (III) that is from 0.2:1.0 to 1.0:1.0.

2. A coated metal article according to claim 1, in which  $Y^1$  in general formula (I) conforms to general formula (III).

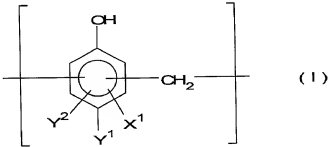
3. A coated metal article according to claim 2, in which the coating comprises a total of at least  $0.1 \text{ mg/m}^2$  of phosphorus atoms present in phosphoric acid like compounds and silicon atoms present in organosilicon compounds.

4. A coated metal article according to claim 1, in which the coating comprises a total of at least  $0.1 \text{ mg/m}^2$  of phosphorus atoms present in phosphoric acid like compounds and silicon atoms present in organosilicon compounds.

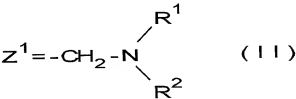
5. A coated metal article according to any one of claims 1 through 4, wherein:

- said coating has a thickness in a range from 50 to 300 nm; and

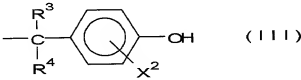
- said coating has a content of carbon atoms that corresponds to from 50 to 200 mg/m<sup>2</sup> of the coating area.
6. A process for providing a surface of a metal substrate with a coating suitable for laminating film thereto, said process comprising steps of:
- 10 (I) providing a waterborne composition that comprises water and:
- (A) at least 0.01 g/L of polymer molecules comprising units conforming to general formula (I):



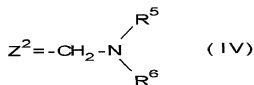
15 in which:  
X<sup>1</sup>, independently in each structural unit, is a hydrogen atom or a moiety Z<sup>1</sup> conforming to general formula (II):



20 in which each of R<sup>1</sup> and R<sup>2</sup> independently is a hydrogen atom, a C<sub>1</sub> to C<sub>10</sub> monovalent alkyl moiety, or a C<sub>1</sub> to C<sub>10</sub> monovalent hydroxyalkyl moiety;  
Y<sup>1</sup>, independently in each structural unit, is a hydrogen atom, a hydroxyl group, a C<sub>1</sub> to C<sub>5</sub> alkyl moiety, a C<sub>1</sub> to C<sub>5</sub> hydroxyalkyl moiety, a C<sub>6</sub> to C<sub>12</sub> aryl, benzyl, or benzo moiety, or a moiety conforming to general formula (III):



in which, independently for each unit according to general formula (I) in which Y<sup>1</sup> conforms to general formula (III), each of R<sup>3</sup> and R<sup>4</sup> is independently a hydrogen atom, a C<sub>1</sub> to C<sub>10</sub> alkyl moiety, or a C<sub>1</sub> to C<sub>10</sub> hydroxyalkyl moiety, and X<sup>2</sup> is a hydrogen atom or a moiety Z<sup>2</sup> conforming to general formula (IV):



in which each of R<sup>5</sup> and R<sup>6</sup> is independently a hydrogen atom, a C<sub>1</sub> to C<sub>10</sub> alkyl moiety, or a C<sub>1</sub> to C<sub>10</sub> hydroxyalkyl moiety;

and

Y<sup>2</sup>, independently in each structural unit, is a hydrogen atom or, when Y<sup>1</sup> and Y<sup>2</sup> are bonded to adjacent carbon atoms in the aromatic ring shown in general formula (I), Y<sup>1</sup>, Y<sup>2</sup>, and said adjacent carbon atoms to which Y<sup>1</sup> and Y<sup>2</sup> are bonded together may constitute a condensed benzene ring,

said polymer molecules that comprise structural units conforming to general formula (I) having a total number of Z<sup>1</sup> and Z<sup>2</sup> moieties and a distinct (but not necessarily unequal) total number of (i) units conforming to general formula (I) and (ii) Y<sup>1</sup> moieties that conform to general formula (III), such that the total number of Z<sup>1</sup> and Z<sup>2</sup> moieties has a ratio to the total number of units conforming to general formula (I) and Y<sup>1</sup> moieties that conform to general formula (III) that is from 0.2:1.0 to 1.0:1.0;

and, optionally, at least one of the following components:

- (B) phosphoric acid-type compounds; and
- (C) organosilicon compounds,

said waterborne composition having a pH in a range from 2.5 to 6.5;

- (II) contacting said surface of said metal substrate with the waterborne composition provided in step (I) for a sufficient time at a sufficient temperature to form a solid coating containing constituents of said waterborne composition, said solid coating adhering to said surface of said metal substrate and being itself covered, at least initially; by a coating of liquid; and

- (III) after step (II), drying the metal surface so as to remove from the metal surface the liquid constituents of the coating initially formed in step (II) or of a successor liquid coating formed by rinsing the surface of said metal substrate as modified after step (II) with water.
- 10 7. A process according to claim 6, in which Y<sup>1</sup> in general formula (I) conforms to general formula (III).
8. A process according to claim 7, in which the waterborne composition provided in step (I) comprises a total of at least 0.01 g/l of phosphorus atoms present in phosphoric acid like compounds and silicon atoms present in organosilicon compounds.
- 15 9. A process according to claim 6, in which the waterborne composition provided in step (I) comprises a total of at least 0.01 g/l of phosphorus atoms present in phosphoric acid like compounds and silicon atoms present in organosilicon compounds.
10. A process according to claim 7, wherein the waterborne composition provided in step (I) contains at least 0.1 g/L of polymer molecules comprising units conforming to general formula (I) and the coating of liquid formed in step (II) is rinsed with water so as to form a successor coating before completion of step (III).
- 20 11. A process according to claim 10, in which the waterborne composition provided in step (I) comprises a total of at least 0.1 g/l of phosphorus atoms present in phosphoric acid like compounds and silicon atoms present in organosilicon compounds.
- 25 12. A process according to claim 6, wherein the waterborne composition provided in step (I) contains at least 0.1 g/L of polymer molecules comprising units conforming to general formula (I) and the coating of liquid formed in step (II) is rinsed with water so as to form a successor coating before completion of step (III).
- 30 13. A process according to claim 12, in which the waterborne composition provided in step (I) comprises a total of at least 0.1 g/l of phosphorus atoms present in phosphoric acid like compounds and silicon atoms present in organosilicon compounds.